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Effective Leg Stiffness of Animal Running and the Co-Optimization of Energetic Cost and Stability

ZhuoHua Shen, Justin Seipel

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## 1 **Highlights**

- 2 • We find that stability and energetic cost are two factors that may interact to influence  
3 legged locomotion.
- 4 • In a simulation study, human-like effective leg stiffness can enable near-optimal energetic  
5 cost or stability when either is optimized independently.
- 6 • However, a tradeoff exists with respect to propulsion (forcing) that limits the simultaneous  
7 co-optimization of energetic cost and stability.
- 8 • Overall, using a multi-variable simulation study, human-like values of leg stiffness were  
9 found to simultaneously yield asymptotically stable or nearly stable locomotion along  
10 with relatively low energetic cost.

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